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2022

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Jalas , M & Rininen , J 2022 , ' Valuing energy solutions in the housing markets : the role of  
p market devices and real estate agents ' , Housing Studies , vol. 37 , n

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<http://hdl.handle.net/10138/355884>

<https://doi.org/10.1080/02673037.2020.1819967>

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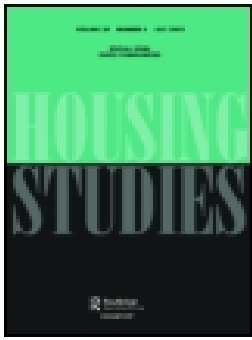
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To cite this article: Mikko Jalas & Jenny Rinkinen (2020): Valuing energy solutions in the housing markets: the role of market devices and real estate agents, Housing Studies, DOI: [10.1080/02673037.2020.1819967](https://doi.org/10.1080/02673037.2020.1819967)

To link to this article: <https://doi.org/10.1080/02673037.2020.1819967>



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Published online: 16 Oct 2020.



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# Valuing energy solutions in the housing markets: the role of market devices and real estate agents

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## ABSTRACT

New energy technologies present opportunities for low-carbon housing but also significant upfront costs for house owners. Due to the long service life of such technologies, market valuation impacts on the feasibility of such investments. Yet, existing evidence on the market valuation of energy investments in private housing is inconclusive. Furthermore, despite significant policy efforts, energy performance certificates remain ineffective. This paper addresses these gaps with a study of real estate agents and the use of market devices, such as tools, databases, classification schemes, inspection protocols and market practices. Our analytical framework builds on the sociology of markets, actor network theory and pragmatist theories of valuation in order to highlight the material and discursive assemblages and arrangements that intervene in the construction of markets. Drawing on empirical evidence from Finland, the results point to asymmetries in market devices and valuation practices that disfavour energy investments compared to the other key quality attributes of housing.

## ARTICLE HISTORY



Received 18 December 2019  
Accepted 26 August 2020

## KEYWORDS

Energy solutions; real estate agents; market valuation

## 1. Introduction

Households have increasing opportunities to invest in energy efficiency and renewable energy technology, but reaping such benefits depends on market conditions and call for market structures which are supportive of household investments. While there is a wide body of literature on the adoption of new energy solutions by households (e.g. Kastner & Stern, 2015; Nair *et al.*, 2010), as well as on newly built low energy houses (Goodchild & Walshaw, 2011; Lovell, 2005), the second-hand housing markets and the valuation practices of energy solutions therein call for further research. Firstly, technologies such as solar photovoltaics (PV), ground source heat pumps (GSHPs), district heating and improved thermal insulation all represent significant upfront costs that are expected to yield economic benefits over a long time. The economic

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feasibility of such energy solutions critically depends on how they impact on property values (Bruegge *et al.*, 2016; Entrop *et al.*, 2010; Harjunen & Liski, 2014; Klise *et al.*, 2013). Secondly, ownership changes are regarded as critical trigger points in energy efficiency improvements (BPIE, 2017) and have hence been in the explicit focus of energy policy via the launch of market information tools, such as the US Energy Star label (Bruegge *et al.*, 2016) and the European energy efficiency certificate (the Energy Performance of Buildings Directive [EPBD]). Yet, the argument of using increased property value as a rationale for investing in energy solutions lacks credibility, and concerns over the market value of the investments legitimate and inform non-action. In other words, making long-term investments in energy solutions calls for a better understanding of the market capitalisation of such investments (Entrop *et al.*, 2010).

The valuation of housing may not, and often does not, follow the professional techniques of real estate valuation but rather draws the prices from housing markets through the more contingent practices of articulating qualities, summoning supply and demand, and organising bidding. Evidence is inconclusive in terms of how (well) the real estate markets work in respect to energy solutions in residential housing (Lande, 2008; Laquatra *et al.*, 2002). Aune (2012) has noted that energy investments and their implications for the use of a house are relatively invisible throughout the marketing processes in the housing markets. Some of the earlier research suggests a systematic undervaluation of energy efficiency (Entrop *et al.*, 2010; Galuppo & Tu, 2010). Lande (2008) has indeed found that homeowners themselves expect redundancy and depreciation in their energy efficiency investments. More recent econometric analysis suggests that energy efficiency labels, investments and good energy efficiency performance are capitalised in the markets of private housing (Bloom *et al.*, 2011; Brounen & Kok, 2011; Bruegge *et al.*, 2016; Harjunen & Liski, 2014). Yet, location, the type of housing and customer segments seem to impact on how 'rational' the market valuation of energy saving technology is (Hoen *et al.*, 2011, 2013; Högberg, 2013). Bruegge *et al.* (2016) presented a finding which is troubling for long-lasting investments, such as PV and GSHPs: a value premium of energy efficiency in detached houses vanishes when houses age and are traded in secondary markets. Altogether, housing prices have been difficult to explain with economic theories (Smith *et al.*, 2006), and these difficulties potentially undermine the diffusion of low carbon housing technology.

Housing markets present a pertaining valuation problem due to the nature of the goods to be exchanged, the significance of individual transactions, and the emotional and cultural loading of the marketplace (Munro & Smith, 2008; Smith *et al.*, 2006). As the products traded in these markets are both singular and multi-dimensional, similar offerings are rare and markets are thus far from ideal. It also holds that households buy houses relatively rarely and are unexperienced in these markets and are particularly unexperienced concerning energy solutions (Lovell, 2005). These characteristics of the housing markets lead home-seekers to make decisions that mix different rationalities, emotions and heuristics; decisions that depend on language and meaning-making categories; and decisions that result in internal conflicts (Levy *et al.*, 2008; Samec, 2016). Smith *et al.* (2006) and Munro & Smith (2008) claimed that

housing markets are ‘performed’, with the effect that decisions reflect cultural and emotion processes, contain uncertainties and cause anxiety (Ariztía, 2014; Corsín Jiménez, 2016).

The roles of real estate agents in valuation have been addressed by sociological studies of housing markets. Firstly, estate agents are perceived to perform cultural work in their intermediary role between different classes, aesthetics and tastes (Bourdieu, 2005; Bridge, 2001). Following this track, Ariztía (2014) claimed that a nuanced understanding of class structures and cultural economy serves as a heuristic for real estate professionals who thereby end up reproducing the same structures in marketing activities. Pertaining to the practice of settling prices, Smith *et al.* (2006), Munro & Smith (2008) and Christie *et al.* (2008) have analysed real estate agents in the Edinburgh housing market. They instilled an image of a rising property market in which decisions mesh with emotions and the anxiety of being in the market. Ojamäe (2013) sheds light on a similar market in Estonia and pointed out that under such conditions, professionals and their market-making practices gain power over residents. Adding detail, Corsín Jiménez (2016) and Samec (2016) described a real estate transaction in terms of individuals being drawn into mortgages via skilful market professionals.

We share these basic premises about value in the housing market as an unstable construct. Yet we adopt a less Bourdieusian approach and veer towards a sociology of markets perspective (Beckert, 2011; Çalışkan & Callon, 2010; Callon *et al.*, 2002; Callon & Muniesa, 2005), actor network theory (ANT) (Latour, 2005) and pragmatist theories of valuation (Barman, 2015; Muniesa, 2011), a tradition which highlights the use of calculative tools and the active performance of calculative actors. In particular, we highlight the role of ‘market devices’, which consist of material and discursive assemblages and arrangements that intervene in the construction of markets, abstract entities for transaction and qualify them (Muniesa *et al.*, 2007). ANT and other micro-sociological approaches to technology stress questions of the active accomplishment of pricing rather than the structures which reproduce the asymmetrical distribution of power (Albert & Kleinman, 2011).

While much of the sociology of markets’ discussion on housing has concentrated on understanding housing prices in general, we aim to use this literature to consider energy solutions as the particular technical properties of private houses. At times of ownership changes, the energy technologies that have previously been bought and installed are ‘put into the market’ in a quite special context. Buyers might not know much about or care for such merchandise. Intermediation in energy solutions is akin to cultural mediation between classes (cf. Bridge, 2001) and may maintain or create value for made investments. Hence, the competence of sellers, buyers and real estate agents, and market devices – such as database structures, search engines, mortgage procedures and the de facto standards of technical surveying – all have implications for the value and worth of energy solutions as they travel through the ‘cultural’ and ‘emotional’ economies of the housing markets. Hence our interventionist interest in who and what could represent and calculate energy investments in the housing markets.

Against this, we detail the following three related research questions. First, *what kind of actor constellations and market devices are involved in transactions in the*

*market for detached houses?* This research question helps us to focus on the structure and characteristics of the housing market. The second question – *how, when and with which tools are energy solutions objectified and made marketable and calculable in the secondary markets for detached houses?* – takes a deeper look at the functions of the market devices. Finally, we ask *what is the role of real estate agents in making energy solutions feature in market transactions?* Rather than asking what is the outcome of valuation, we focus on the processes and tools of producing a market value for housing. Combined with our conceptual approach, building on ANT, we add understanding of the ‘calculative character of markets’ (Callon & Muniesa, 2005) via an inclusive exploration of heterogenous market devices and actors. Taken together, we contribute to the understanding of how policy-relevant and technologically unstable housing attributes are valued.

The empirical focus of the paper is on the market exchanges of residential, detached, single-family houses in Finland. Whilst the Finnish cold climate necessitates high investments in heating systems, the same problem exists at lower latitudes with, for example, PV. We draw the empirical material from interviews with both real estate agents (interviews with 17 agents) and households who have recently bought a house (interviews with 15 households). Whereas the results of the household interviews have been previously published (authors, 2016, to be added in the list of references), this paper focuses on the interviews with real estate agents and their market practices. We also draw on first-hand experience of attending viewings of detached houses, engagement with market devices and quantitative evidence from the prominent internet sites for housing offerings for the Finnish market.

The article begins with an introduction to market devices as the conceptual framework. We then describe the Finnish context of housing markets and real estate practices, and the data and methods that we use. The empirical analysis starts with a reflection on the market devices in use, and then moves on to unpacking the roles of the real estate agents. In the discussion section we return to the research questions in order to discuss how houses are made calculable, and conclude with policy implications and considerations for further research.

## **2. Valuation practices and market devices in the housing market**

A pragmatist view on valuation breaks apart from the conventional economic theories of value in highlighting that prices are not only determined by external factors – such as supply and buyer preferences – but are also determined by the way in which market exchanges are organised and facilitated by market devices (Barman, 2015; Muniesa, 2007, 2011). It also follows that value is an active accomplishment of intermediation which involves the particular procedures of making goods calculable and performing the pricing (Çalışkan & Callon, 2010).

ANT’s adherents see the market as an institution which mixes humans and non-humans and controls their relations. As Callon (1997) noted, with its focus on the role of technical devices and scientific skills in the performing of the collective, ANT highlights the importance of material devices in the performing of the economy. ANT thus suggests an interest in a number of arrangements that allow for *calculation*

– distinction between the things or states of the world, and the actions associated with those things – namely, objectification and singularisation (Callon & Muniesa, 2005).

Callon & Muniesa (2005) argued that any product or service must be objectified in order to be exchanged in the market. *Objectification* refers to the procedures that detach the goods from the seller, stabilise them and make them transferable to the buyer and to the materiality of what is being exchanged. The objectification of a house might appear straightforward as property rights delineate clear borders around a house. However, the rights of ownership of energy-related installations may be meshed with a leasing arrangement, warranties, maintenance services (Klise et al., 2013; Rai & Sigrin, 2013) or, for example, in the case of wood-burning devices, fuel supply arrangements. Finally, real estate may be subject to liabilities which bind sellers and buyers together.

*Singularisation* is the second key process of market transactions (Callon & Muniesa, 2005). It refers to the iterative process through which a product is made valuable and refers to ‘a gradual definition of the properties of the product, shaped in such a way that it can enter into the consumer’s world’ (Callon & Muniesa, 2005, pp. 1233–1234). Through singularisation, a good is placed in a frame with other relevant goods. It is the attributes of quality and settings of comparison that make the good calculable.

The construction of markets and prices for such goods as proper insulation, installed rooftop PV panels or GSHP systems is a complicated effort of calculation because investments related to energy solutions are bundled in with other characteristics of the house. While no houses are the same, statistical methods can be used to make comparisons. The hedonic regression method suggests that houses can be viewed as a bundle of attributes and compared as an aggregate of particular attributes that can be priced separately. This is a calculative device that real estate agents use when they draw house prices from existing markets (Smith *et al.*, 2006). Using comparable sales is also prevalent in the pricing of integrated PV installations (Klise et al., 2013). Yet, the method is particularly problematic for the early stages of technology diffusion because comparative sales are few.

The prevalence and dominance of any valuation theory or arrangement is an achievement of organising pricing. Using comparative sales as a proxy for prices is partly due to a lack of effort, sophistication and skill: for example, the cost of replacing current installations could indicate value, but estate agents lack apprehension of the depreciation of the equipment and technological change (Klise et al., 2013). Such information is not part of the conventional valuation practices of real estate agents. In principle, energy-related investments can also be priced by approximating the savings they create (Klise et al., 2013), but such savings can seldom be measured. ‘Discounted future cash flows’ are not possible for several reasons, including the technical problems of measurement and uncertainties regarding the service life of equipment and future energy prices.

From the point of view of ANT, markets are seen to consist of agonistic relationships between different valuation schemes (Çalışkan & Callon, 2010). Conflict and negotiation around the qualification of goods takes place in a non-altruistic process



that ‘different economic agents can manipulate to suit their strategic goals’ (Callon *et al.*, 2002, p. 200). For the price formation of energy technologies, this raises the question of both timing (past sales or future savings) and the valuation scheme (cost–benefit analysis or comparable methods). The nature of detached houses highlights yet another problem for valuation: the qualities refer to highly heterogeneous valuation schemes. Whilst the key quality attribute – location – is clearly a positional attribute and discredits any ideas of ‘proper’ valuation, energy investments refer to the different schemata of future savings and discount rates. Barman (2015) pointed to difficulties in comparing quality attributes that refer to different valuation schemes, and there are good reasons to expect that the housing markets are also rife with such difficulties.

Any meticulous practices for estimating the real value of energy instalments are questionable when used as accurate descriptions of how housing markets work. Smith *et al.* (2006) and Munro & Smith (2008) have utilized Callon’s theories to study exchanges and pricing in a rapidly growing market but added a behavioural and psychological tilt to the approach. They argued that home-seekers are often uncomfortable in the market. Rather than engage in information seeking, speculation and extended comparison, they invest in being able to secure a home and get out of the market. The anxiety of being in the market may account for the frequent ‘sudden’ encounters with the perfect and ideal house in the markets (see, e.g. Corsín Jiménez, 2016; Levy *et al.*, 2008). Market transactions and pricing include an unfolding process of exchanging information (Allen *et al.*, 2018), and thus time in the market and temporalities, such as anxiety, impact the market value of investments.

Valuation of real estate may occur, and often in practice does occur, in the absence of markets. Professional appraisers perform valuations for purposes such as insurance, mortgages, and mergers and acquisitions, as well as for the partition of an inheritance. In all these instances, the real estate is not put onto the market, valuation rests on impartial professional judgement as well as on theories of and data on value formation. The opposite of this, real estate auctioning (see, e.g. Christie *et al.*, 2008), draws prices from the markets. As we will show in our empirical analysis, in the case of Finland, real estate agents are hired by sellers, with whom they settle a realistic asking price which is higher than the anticipated final sale price. Such agents act according to the logic of professional valuation and appraisal even if their judgement is subject to a ‘second pricing’ at the housing markets. This is despite the fact that real estate agents in Finland very seldom have training in property valuation.

Markets are structured by devices, but they are also populated with human actors who use the tools and conduct the exchanges. While real estate market actors have been approached as intermediaries (Bridge, 2001; Levy *et al.*, 2008; Smith *et al.*, 2006), little research has been done on the potential role of real estate agents in intermediating energy transitions. A market device approach points to the joint agency of human actors and tools that equip them with agency. Whilst the ANT approach has been criticised from both the viewpoints of political economy (Fine, 2005) and structural sociology (Elder-Vass, 2008), mainly for lacking ontological depth and for its inability to recognise significant mechanisms, we maintain that its benefits lie in



**Table 1.** Annual heating costs, calculated for a 110 m<sup>2</sup> detached house in southern Finland (Motiva, 2017).

		Direct electricity	District heating	Oil boiler	Ground source heat pump
Capital costs	€/a	389	584	623	1245
Fuel / service costs	€/a	2782	1751	2477	949
Total costs	€/a	3171	2335	3100	2194

tracing the connections through which structures are constantly made and remade, and in acknowledging heterogenous human and non-human entities.

### 3. Studying the housing stock and real estate markets in Finland

#### 3.1. The Finnish housing stock and prevailing options for heat provision

Finnish detached houses number roughly 1,050,000 units, of which roughly half have been built since 1960 (Statistics Finland, 2017). The average house size was 110 m<sup>2</sup> in 2016 (SVT, 2016). Compared internationally, a high share (71%) of Finns live as owner-occupiers (the respective figure in the UK, for example, is 65% [Barton, 2017]). Moreover, as a vast majority of rental homes are apartment buildings, detached houses are, in practice, owned by the occupants. Since 2015, 14,000 to 15,000 houses have been sold annually (Statistics Finland, 2020).

In 2009 the most prominent source of heat in Finnish detached houses was electricity (44%), used either directly in electric heat units or in a centralised boiler. Wood burning boilers had a share of 25%, oil boilers 22% and district heating 6% (Vihola & Heljo, 2012). District heating is regarded by users as a secure and easy supply system (Paiho & Saastamoinen, 2018), but it is only available in the larger cities. GSHP technology was developed in 1970 and uses a heat pump unit to retrieve heat from low temperature ground or from 100–200 m deep heat wells drilled for the purpose of heat retrieval. During the 2000s, GSHP sales accounted for a prominent investment in renewable energy (Heiskanen *et al.*, 2017). They are the dominant solution for new houses and are also frequently used to substitute for the boilers of central heating systems. In 2014, GSHPs' already had a share of 10% in the exiting housing stock according to retailers. PV and solar thermal installations are rare in Finland (Heiskanen *et al.*, 2017) and do not yet feature in the second-hand housing markets. The same holds for the energy efficiency categories such as the passive house category.

Estimates for the costs of different heating systems are presented in Table 1. They comprise of capital and operation costs. Retrofit and conversion options depend on the existing technologies: if the house has a central boiler operated either by oil, electricity or biofuels, conversion to GSHP and to district heating in urban areas is rather simple. Houses with no central units are commonly retrofitted with cheaper air-to-air units for room-specific heat provision.

A government subsidy is available for retrofits through a tax deduction scheme, which has allowed individual taxpayers to deduct up to 2000 euros from taxes based on the labour costs of household and renovation services since 2012. In addition, there has been a subsidy available, based on socio-economic disadvantage, that covers a maximum of 15% of the investment costs of energy renovations.

**Table 2.** Interviewed real estate agents.

	Gender (M/F)	Area	Experience as agent	Length of the interview (min)
1	M	Smaller southern city	7 years, has been in the construction business	43
2	M	Metropolitan	1 year	44
3	M	Smaller southern city Turku	6 years	60
4	F	Smaller southern city, Porvoo	1 year	38
5	F	Smaller southern city, Turku	4 years	48
6	M	Smaller southern city	5 years	60
7	M	Metropolitan area	20 years, has also been in construction business	61
8	F	Metropolitan area	10 years	56
9	M	Smaller southern city	25 years, head of office	44
10	M	Metropolitan area	8 years	47
11	F	Metropolitan area	3	53
12	F	Smaller southern city	13	45
13	M	Smaller southern city	7	32
14	M	Smaller northern city	20, Head of small office	26
15	M	Smaller northern city	22	30
16	M	Smaller northern city	8	15
17	F	Smaller Southern city	20, Head of large regional office	52

### 3.2. Methodology and data

An inquiry into actor networks should account for heterogeneous realities which enter into ‘the fabrication of some state of affairs’ (Latour, 2005, p. 92). Moreover the methodological principles of ANT highlight (1) the porous border of the ‘human’ and the ‘non-human’, (2) the ongoing making and performing of relations in networks and (3) the punctuated hierarchies of power whereby some entities come to represent others for a time (Bueger, 2013). These premises lead to an emphasis on ‘technologies in use’, the ‘enactment of theories’ and, in the case of our study, the ‘performance of pricing’ in housing markets. On a methodological level, we interpret this as a requirement to understand the process of pricing, which is accessible by cross-examining observations of the tools in the markets and combining them with self-reported accounts of the practitioners of pricing.

In the following we draw on 17 face-to-face interviews with Finnish real estate agents working in the Helsinki metropolitan area ( $n=6$ ), other growing southern cities ( $n=8$ ) and in a northern city in a region with a declining population ( $n=3$ ). The interviews were recruited by scrolling through the sales adverts of detached houses in the selected cities. The acceptance rate was high and over 70% of the initial contacts resulted in an interview. The interviews lasted on average 44 minutes and were conducted with real estate agents, of whom 11 were men and 7 were women, and who had expertise in the field ranging from 1 year to 25 years. Information on the interviewed agents is compiled in Table 2.

We interviewed real estate agents on their experiences and views of trading different energy technologies. The interviews with real estate agents were semi-structured and covered the following themes: their background and experience of working as real estate agents, their views on the role of different heating systems when selling

and buying a house, their means of marketing and estimating the prices of the houses with different energy performance and the overall determination of the market value of detached houses.

The interviews were held in Finnish, recorded and transcribed, totalling 161 pages of material. The excerpts included in this paper were translated into English by the authors. The interviews were coded in NVivo. Using a grounded theory approach, following list of codes emerged from the interviews:

1. Formalised processes, tools, databases and information practices which relate to transactions in the housing markets
2. The performing of the transaction and the practices of handling the energy-related aspects of housing in market transactions
3. Understandings and explorations of the market value of detached houses and price formation
4. The linking and delinking of previous and new owners
5. Normative justification of the existing practices of real estate agents, as well as elaboration of the differences within the profession and the potentially larger role of real estate agents in the pricing of energy solutions.

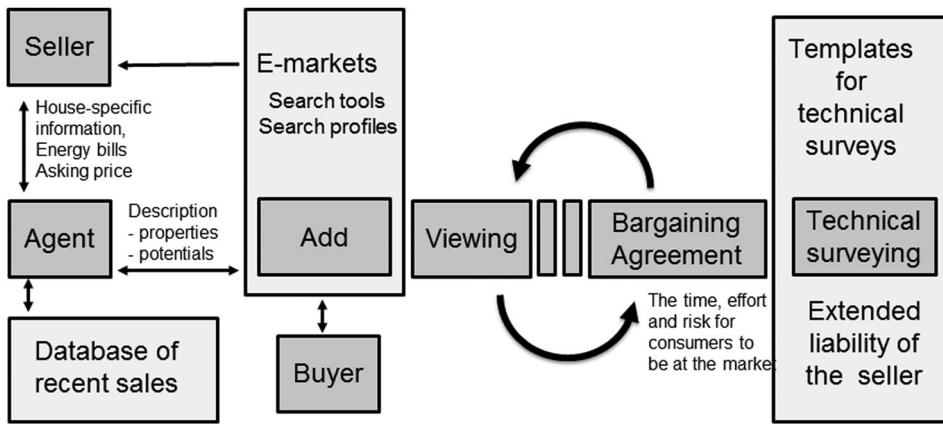
In addition to interviews with real estate agents, market devices were further researched by engaging with them; by using the most prominent search engines, by reading technical reports and by attending viewings of detached houses we gained an understanding of use of the market devices and interactions in the market from the point of view of a buyer. We also interviewed house owners as previously reported (author study, 2016) and the companies who operate online services.

The following section, Section 4, is organised according to the NVivo coding categories. It draws on the interview data and supplements it with the secondary data on housing markets and market devices. The discussion in Section 5 draws attention back to the research questions.

## **4. Making houses calculable**

### ***4.1. Formalised processes, tools and databases related to the brokering of detached houses***

Electronic internet-based databases, known as *multiple listing services* (MLSs), enable market actors to compile a set of offerings, and filter and rate them with different criteria. There are two major MLS marketplaces for detached houses in Finland (the E-markets in [Figure 1](#)). Etuovi (etuovi.com) was the market leader with more than 1,000,000 housing advert searches weekly. Of these searches, 32% were for a detached house. Etuovi, unlike the other major service provider, also allows for heating systems to be used as a search criterion. In 2013, this criterion was used in 1.7% of all searches (Huttunen, 2014). Presuming that this is only relevant for detached houses, roughly 5% of the searches on detached houses used the criterion of the heating system. It allows users to mark a request for a specific heating technology: district heating had the most marks, followed by GSHP, electricity, wood and finally oil. We do



**Figure 1.** Key market devices and actors at the Finnish housing market.

not have data on the combinations of search criteria that users have made and cannot indicate whether (and if so, how) buyers screen out single technologies. In November 2018 at etuovi.com, offerings for the most preferred solutions were low (district heating 9% and GSHP 8%), and high for the less preferred solutions (electricity 30% and oil 14%). Houses with both electricity and wood heating made up 23% of the total offerings of 14,300 houses, and houses with no indication of their heating system accounted for 13%. Hence, the most used search criteria are for the least available heating solutions, but overall the criteria are not used extensively.

Most real estate agents in Finland are hired by sellers based on an agreed starting price for downward bargaining, with a flat rate commission and a contract with a termination date. In 2015, the sales times of detached houses, excluding the marketing efforts of previous agents, was 108 days for the metropolitan area and 132 days for the rest of the country (KVKL, 2020). Before the offerings are placed on MLSs, the first valuation has thus already taken place as the agent and the seller have agreed on the asking price. For this purpose, agents consult a database of previous transactions that is maintained by the Central Federation of Finnish Real Estate Agencies, which accounts for approximately 80% of the transactions. According to the provider, the database contains little sophistication beyond providing the location and other key features of the sold properties. This database has no data category for heating systems and contains no data on energy retrofits. After an analysis of comparable sales, agents negotiate the asking price with the seller. Asking prices, when governed by such technologies of ‘comparable sales’, thus follow the previous sales prices of houses with similar attributes in terms of location, size, age and technical properties. Yet, the methods real estate agents use are far from having econometric sophistication, and it is conceivable that novel energy solutions are underrated because of a lack of a comparative set of previous sales.

A key device for making more idiosyncratic judgments is a technical survey conducted by professional building surveyors. The interviewees emphasised the role of the survey as a way to ensure the technical and structural soundness of the house and avoid future liabilities for the seller. Interestingly, the surveys we viewed had little to say about energy solutions beyond providing basic data on the heating system, its

technical condition and expected lifespan. In an earlier study, Kinnunen (2013), interviewing 21 Finnish agents, did not find any evidence that detected that flaws in energy solutions had contributed to lowering the price. Amongst our interviews, the logic of technical surveys was perceived to point out defects and renovation ‘deficits’ which might be directly deducted from the asking or agreed sales price rather than to address the operating cost and energy efficiency of the installations. An extended liability of the seller underscores the practice of technical surveying. By law, in the Finnish housing market the seller is responsible for any defects which were not apparent at the time of the sale for a period of five years (we discuss this in more detail below).

The energy efficiency certificate introduced by the EU, the EPBD, is a market device designed to effectively convey information about the energy efficiency and performance of a house. It is a rating that is based on the technical specifications of the house and renders a calculation of energy consumption per surface area and offers a comparison within a reference group. Additionally, the law on the energy performance certificate also suggests that the document includes suggestions for improvements. The Ministry of the Environment, which is responsible for the certification schemes, has issued templates and examples for the certificates. An example of advice for a house from the year 2000 is as follows:

The building is in good condition and there is no immediate need for any measures to be taken. However, energy efficiency can be improved by replacing windows, improving the insulation of the roof, installing an air-to-air heat pump and by replacing the air supply unit. (Ministry of the Environment, 2013; translated by the author)

The certificate has been mandatory since 2013. Yet, the practice in the market did not reflect this. Highly abstract and decontextualised, the performance rating was broadly discredited amongst our interviewees. This reflects a severe criticism that includes an ongoing citizen ballot initiative and a state committee for preparing changes in the execution of the EPBD. Overall, law enforcement has been lax and, from the beginning, detached houses built before 1980 were exempt from the obligation until July 2017, which made the certificate even more peripheral for the interviewees. Even if the certificate was mandatory for newer houses, we hardly ever found them in the market. The agents stated that they would rather use the evidence of the real energy costs of previous owners as a proxy for the costs for new residents.

#### ***4.2. Performing the transaction and the practices of handling the energy-related aspects of housing in market transactions***

Besides the use of tools and protocols of pricing, face-to-face interaction, the temporal unfolding of pricing and various heuristics of actions in the housing market affect the value of energy solutions. Auctioning (which is in very limited use in Finland and only used for easy-to-trade city apartments) operates within a narrow time frame. Singular, detached houses trade differently: on average a successful agent had marketed a detached house for 3–4 months before the sale (KVKL, 2020). In addition there may have been unsuccessful precursors. In the Finnish practice, the initial price is an important benchmark: a final price which is less than 90% of the initial

price is regarded to signal an incompetent and flawed initial valuation by the agents. On the other hand, a too rapid sale is also a sign of flawed pricing. This indicates that the pricing of the property and the energy systems therein takes place, to an important extent, between the seller and the real estate agent.

The anxiety of being in the housing market is another facet of the temporal unfolding of prices. When asking about the way in which buyers use peer support when viewing houses, we encountered not only troubleshooting and bargaining, leading to extended market presence, but also support for arriving at a positive buying decision and being able to exit the market:

Interviewer: This 'peer support', is it to reduce prices?

Interviewee: Yes, yes. Or then it is looking for good in it [the house] – looking for why it is good with the ground heat pump. (2)

#### ***4.3. Understandings and explorations of the market value of detached houses and price formation***

The interviews brought forward different valuation heuristics. The labels of the heating system are used as a quality and pricing proxy; put bluntly, GSHP systems and connection to district heating are regarded as clearly positive attributes whereas using oil and direct electricity as heating sources are regarded as a handicap. In terms of such a handicap, the opinions of the real estate agents differed. Some framed oil-based heating as a non-negotiable stigma, as can be seen from the extract below:

Yesterday I had the first viewing in one [house] that still had oil heating. I even had those who turned on their heels on the spot. (14)

Some of our respondents were of the opinion that it makes economic sense to 'fix' oil-heated houses with a GSHP before putting them onto the market. However, as we highlight below, this can be done more subtly as real estate agents can intervene by suggesting renovations. Hence, oil-based heating, which is relatively easy to convert to a ground source heat system, can be viewed much more positively as a project. GSHPs, in turn, are currently 'black-boxed' and regarded in general as proper, value-increasing energy solutions. Despite evidence that GSHPs do not always yield the anticipated benefits and despite the fact that there are important qualifications to these systems – such as the depth of the heat well and the quality of the soil – buyers do not pose questions about GSHP instalments. In a similar vein, if the consumption figures are within a proper range (e.g. 20,000 kWh per annum for direct electricity heating in Finland), energy solutions arouse little discussion.

Although such binary distinctions are made concerning heating systems, the way in which they affect pricing is conditioned by other binaries. Location apart, the interviewed real estate agents used the general 'condition' of the house as one key proxy for setting the price and for knowing whether energy-related issues warrant particular attention. When replying to our direct question about whether an investment of 20,000 euros in a GSHP system would pay off at the point of sale, the agents frequently referred to the general condition of the house. A house which is generally in good condition benefits from GSHP investment, but if the house has not been

otherwise maintained, agents doubted the economic logic of making GSHP investments prior to selling the house. Energy investments are thus perceived through their potential to make categorical differences beyond those of energy solutions and bundled with other indicators of the up-to-dateness of the house.

#### **4.4. The linking and delinking of previous and new owners**

*Objectification* refers to the processes which separate entities to be traded from their contexts. Energy-related instalments are problematic from the point of view of objectification because the used valuation methods frequently make reference to the residents who are part of the context. Insofar as the existing historical record of energy expenditure is used to evaluate energy instalments, the behaviour of the seller is an elemental part of the value of the system.

We asked the agents about their strategies for selling houses with poor energy performance. One strategy was to seek to objectify the house by giving out information about previous users including, for example, a listing of the heated spaces, the number of water-hungry teens and the indoor temperatures. This, however, remains limited and sketchy due to the lack of detail and concerns about privacy, and thus it is often beyond current practice, as can be seen in the below quote:

Interviewer: Do potential buyers ask about the previous family?

Interviewee: Yes, like, what kind of family they were – how big and how many children – but very few ask anything [about behaviour]. For sure, they wouldn't even think that an agent would know how often the seller takes a sauna. (8)

Thorough objectification is an ideal. In the case of detached houses, the sheer complexity of the product implies that trust is involved in transactions. Despite technical surveying, the instruments for measuring and examining the house and the crawling bodies of buyers, sellers, agents and experts – all attempting to fully inspect the house – uninspected aspects remain. Due to these aspects, items such as well-ordered house manuals, tidy central boiler rooms and the occupational status of the sellers represent and speak for the house and for its quality.

The complexity of the product also implies that ownership changes require the transfer of tacit user experience in addition to codified knowledge. The interviewed real estate agents emphasised the need to provide sufficient instructions for new owners. This includes an 'operational manual', which is a set of user instructions handed from the previous owner to the next and it frequently also includes a list of spotted projects or needs for repair. Real estate agents convey and add to such opportunities by envisioning modifications in energy solutions, either by add-on strategies, such as new fireplaces, or by conversion strategies, such as converting from oil-based heating to a GSHP or from electricity heating to an air-to-air heat pump. As a result, the house as a commodity is often augmented with energy-related projects and more or less accurate cost estimates.

The extended liability of the seller in Finland, covering five years after the sale, further obstructs objectification. Even if the house is well inspected and the new residents are well instructed, the qualities of the counterparts matter for the sellers and



thus enter market valuation. In the following, an agent gives an account of how the price depends on who is buying the house and their skills in using it:

Well, I usually warn the seller if it looks like the buyers can't – and don't know – well I – particularly if the offer is low – I plead that it is not worth selling to these buyers because there may be problems later, even if we try hard, for they may not know how to live in this house. (7)

#### **4.5. The remit and normative justification of the practices of real estate agents**

Finnish real estate agents operate with little jurisdiction: the business is in principle open to anyone and the corpus of 4500 active agents is highly volatile (Ehnrooth, 2020). However, the Finnish Chamber of Commerce organises an exam for a real estate agent status, which relates to the legal and regulatory aspects of real estate. In 2020, over 16,000 people took the exam. A formal qualification on property valuation is much scarcer as the database of the Chamber of Commerce only lists 250 qualified appraisers. The majority of the interviewed agents had taken, or were in the process of taking, the LKV exam. Their knowledge of the technical aspects of housing varied greatly and depended on their individual work history and inclination.

As our research design is informed by the recognition that real estate agents are active participants in making the markets for detached houses, we also probed their views on the remit of a real estate agent and their willingness to expand their role regarding energy solutions. Role stretching appears to hinge on the professional ethics of real estate agents and their competence. The agents claim that they need to be honest and point out the flaws in the house and correct misguided expectations about energy costs. Below an interviewed agent reconstructs how flaws might be discussed with a client:

If we know it's an old and bad house, with high electricity bills, we have to frankly say it is a bad system: 'I guess you saw the water dripping from the roof' [gestures as if pointing out a defect indicated by the melting snow on a poorly insulated rooftop]. (7)

Quite expectedly, the agents' personal experience of energy solutions is indicative of a more active market role. Following this logic, in the text below a seasoned agent foresees the role of a neutral semi-expert – not qualified to the level of a technical expert but nevertheless using his or her position of having seen multiple houses and being a professional in the housing field:

With this experience, if you can give advice to people, it has a big impact. I think the agent should act as an advisor too. (15)

The role of an advisor includes different things for different agents. While the seasoned agent above might extend his role to organising, for example, infrared imaging, others merely give the contact information of building and energy professionals and only engage in envisioning energy improvements on a general level. On the other hand, many limit their active role to situations in which the potential buyer actively raises the issue; they doubt their own skills and the desirability of acting as an energy expert, as can be seen in the text below:

If I start to give too much advice to the buyer, they will consider me a fool: Why are you explaining these things to us when we never asked you to? (6)

The technical survey (see [Figure 1](#)) opens up a new interaction space. In general, all agents agreed it to be standard practice (except in new houses). However, there are different practices for carrying out the survey. Some of the agents prefer to commission a building surveyor prior to pricing the house and putting it on the market as if to objectify the merchandise:

It speeds up the sale and gives a more reliable impression about the house, and if there are problems [with the house], I can agree the price with the seller because it is the problem of the seller. (4)

The larger share of agents prefers to conduct the survey with the prospective buyer. This practice facilitates a thorough inspection of the house and a materially embedded discussion in which the agent can remain neutral but, in any case, have a decisive role as an initiator. On the other hand, the former practice reflects a more distant role of the agent – setting the price based on product characteristics prior to putting it on the market.

## 5. Discussion

Our first research question turned attention to the actor and devices of housing markets. Callon & Muniesa (2005) perceived a conflict in calculative devices and argued that a compromise in markets is not so much about value as about how to calculate value. A compromise so reached configures encounters with various levels of computerisation and automata, and produces asymmetries. In the case of setting the price of detached houses, our respondents supported the collective agreement that location overrides any other product characteristic. They reported little to no use of formal tools, such as hedonic regression, to capture and account for the heterogeneous quality attributes of housing. The perceived dominance of location as a quality attribute is reinforced and reproduced by the calculative devices such as MLS databases that allow for location-specific pricing history to be accessed and that, on the other hand, do not store, and thereby do not facilitate the search for, the quality attributes of energy solutions. Hence, existing market devices come to represent and stabilise particular quality attributes and reproduce buyer preferences regarding such attributes.

Part of the difficulties in bringing forward the value of energy-related investments is due to the nature of the goods traded: detached houses are highly singular goods – each house differs from others in terms of location, size, age, construction methods, floor plans, general condition and heating systems amongst other things. The goods exchanged in the housing markets thus comprise of a bundle of quality attributes, amongst which the positional attribute of *location* and the operational attribute of *energy solutions* refer to different valuation schemes. The pricing of energy investment depends on, and is currently partly hampered by, such differences and asymmetries in devices. Yet, this tentative conclusion calls for empirical research both on the architecture and the actual use of the devices.

Beyond the databases and their structure, regulations – such as the EPBD and the extended liability of the seller – may impact on valuation. Firstly, whilst not directly

supported by our data, liability law may be conducive to fixing and stabilising the traded goods and to buyers being able to arrive at a decision. It is also conceivable that liability law lessens the interests of buyers in the technical systems of the house and may contribute to a lower valuation for them. There is also a secondary effect: liability law contributes to the preference for a technical survey to uncover potential risks. This is a potential discursive space in which to engage with energy solutions which, however, currently remains largely unused. The role of the EPBD energy performance certificate in the Finnish market was insignificant but pending.

Our second research question was about how, when and with which tools energy solutions are objectified and made marketable and calculable in the secondary markets of detached houses. A potential obstacle in the value formation for energy systems is the lack of thorough objectification. The energy solutions – insofar as energy consumption figures are their key reference – are entangled with the behaviour of the residents. New houses do not have the same problems and energy investments have been found to capture a price premium (Bruegge *et al.*, 2016). Our results resonate with this finding and indicate that objectification may be a key problem: that is, second-hand systems come with the baggage of questions, such as questions about who installed them and how one should live with them. Moreover, it is conceivable that new houses make implicit reference to the latest building standards and other standardised solutions, and that their energy solutions thus require less elaboration and effort of calculation. This highlights the need for tools to create transparency and trust in energy system improvements in the second-hand housing markets.

One of the key findings of this paper is that energy-related investments are valued through contingent practices and rough binaries: GSHPs and district heating are signs of superior quality over both oil and direct electricity. Another key heuristic which affects the valuation is *the condition of the house*: if energy investments are able to make a categorical difference per condition, real estate agents can be regarded as contributing to a higher value of the house. The overriding importance of heating energy demand and the capital-intensive options for lowering the costs, namely GSHPs and district heating, are distinctive features of the Finnish housing stock. Such icons of superior quality in energy solutions are easy to communicate. Our findings support this as GSHP systems and connection to district heating were regarded as clearly positive attributes. Yet, our results on difficulties in valuation and on the real estate agents' perceptions of undervaluation contrast with the results of Harjunen & Liski (2014) who found evidence that (at least in the rising markets of the Helsinki metropolitan area) a district heating connection was capitalised more or less fully in the housing prices.

Future policy options and the current failure of energy performance certificates hinge on both objectification and singularisation. The aim of the certificates is to make information on previous residents redundant, in order to highlight energy performances in the market place and to enable the comparison of the energy performance of buildings. Yet the discrepancies between the certificates and energy consumption history of the building, involving resident behaviour, erode trust in the certificates.

Our results point out that real estate agents matter for market valuation: firstly, they provide an initial price estimation for market entry, and secondly, they organise and participate in the market dialogue. Improved professional qualifications would support the valuation of energy investments. Yet, the pragmatist approach to valuation highlights devices in use and the way in which they assign agency to human actors. Whilst devices such as MLSs, technical surveying and EPBD tools exist, their impact depends on how they equip and mobilise actors such as real estate agents. Accordingly, the role of the real estate agents could be enhanced by changes in the devices, including the MLSs, so that they include energy system data.

Beyond this, the agency of real estate agents depends on at least the three following aspects. Firstly, their agency depends on their abilities and will to take a more active role; personal experience of heating technologies appears to be conducive to active participation in valuation. Secondly, role stretching calls for opportunities: the technical surveying of houses creates room for a thorough discussion of the house in which real estate agents participate even when not implicated by the liability law. The third aspect is based on opportunities for energy improvements. Such opportunities arise from available new technology which is standard enough to get real estate agents involved. Referring to such solutions, the real estate agents may act to turn a property into a project.

However, active involvement in the valuation of energy solutions stretches the remit of real estate agents and calls for professional reorientation. Most of the agents we interviewed did not want to expand their professional activity into advising or projecting energy improvements. The role of an advisor puts them into a position in which they may currently have little expertise and which contradicts their basic logic of getting houses quickly sold at acceptable prices. Moreover, as a professional group, real estate agents have traditionally enjoyed little trust (Larsen *et al.*, 2007). Efforts at policy and market development should recognise these limits.

The concept of market devices complements economic studies of valuation, which yield different insights into housing markets. For example, the incentive structures of real estate agents may significantly affect valuation and the premium prices for energy efficiency. Economic theories of information asymmetry (e.g. Akerlof, 1970) also provide material for theoretical reflection. If the valuation of energy solutions was severely hampered, these theories would expect a lack of good quality products in the marketplace, which, according to our results, is not the case. On the other hand, such theorisations overlook the special character of housing markets. In the case of owner-occupied detached houses in Finland, people are in the markets for reasons other than speculation (Rinkinen & Jalas, 2017). Moreover, whilst markets are frequently considered an agonistic power struggle between different valuation schemes (Çalışkan & Callon, 2010), domestic investments in energy solutions rather point to a lack of calculating devices and intermediation. For various reasons, homeowners make investments not knowing or even expecting a low level of capitalisation on their investments at the markets (Lande, 2008). We hold that a market device perspective on how valuation is done is informative when markets are ridden with such difficulties.

A pragmatist view on valuation also resonates with the anxiety of being in housing markets (Smith *et al.*, 2006; Munro & Smith, 2008). Valuation according to this view is work that needs to be performed. Questions of what does and should enter valuation and how valuation should be done pertain to any market transactions and are never fully settled. The housing market of positional and unique goods amplifies this anxiety and puts valuation in a time-constrained environment: a house needs to not be sold too quickly, nor too slowly.

## 6. Conclusions

The aim of this paper has been to understand the way that long-term investments in energy solutions in housing get actively valued in and through market transactions. Whilst better understanding of the valuation of energy solutions is perceived to be conducive to and critical for their wider diffusion, the empirical evidence of valuation is inconclusive. Our results highlight a contingent process of valuation that depends on available market devices; the use of different valuation schemes, data, the technical competence of and competition between real estate agents; and concerns over liability for sellers. The results point at a devaluation of energy investments in the second-hand housing market. Only a minority of the real estate agents we interviewed were of the opinion that energy investments are valued to match the incurred costs. Despite significant policy effort on energy performance certificates, such as the European EPBD, such devices have struggled to make a difference in the market transactions. Moreover, less apparent market structures, such as MLS databases, appear to underrate energy investments. The technical surveying of property is a standard practice, but both the formula for the survey, as well as previous empirical results (Kinnunen, 2013), indicate that such surveying is not effective for forming value for energy investments.

Our analytical framework builds on the sociology of markets, ANT and pragmatist theories of valuation, and it highlights the material and discursive assemblages and arrangements that intervene in the in price formation and the construction of markets. A basic premise of the sociology of markets is that prices are actively made and calculative actors are performed through the use of particular market devices. For the study of housing, our discussion on the market valuation of energy solutions contributes to the identification of the broad constituency of valuation starting from available data, alternative economic schemes to the role of human skill and attention as the formative elements of pricing. Finally, as energy solutions evolve and vary significantly between property types, studies across the phases of technology diffusion and across property type are needed.

For policymakers, a device perspective offers multiple distinctive leverage points. We found devices, such as the extended liability of the seller, that offer support for the valuation of energy investments and potential (currently ineffective) devices, such as the energy performance certificate and the technical survey. We also highlighted less obvious but potentially highly significant asymmetries in market devices that favour location over other attributes, such as energy solutions. However, the failure of energy performance certificates indicates that a better understanding of housing

markets and valuation practices is needed. Domestic energy solutions may be put into frames that are not about performing calculations but about adhering to rougher binary logics. Whilst few people shop for ideal energy solutions in the housing markets, these technologies become peripheral and only need to be evaluated in terms of categorical differences. Emerging, more complicated technology will further challenge the making of qualitative differences in domestic energy solutions. This and the image of the anxious consumers who are seeking to secure a decent home suggest a key role for the design and study of market devices from the point of view of energy solutions.

### Disclosure statement

No potential conflict of interest was reported by the author(s).

### Funding

This work was supported by the Strategic Research Council at the Academy of Finland under grant number 327771.

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